

AD-A056 962

HAWAII INST OF GEOPHYSICS HONOLULU

F/G 14/2

CONVERSION FROM FILM TO MAGNETIC CASSETTE RECORDING FOR THE GEO--ETC(U)

APR 78 A I NAKAMURA, R R HARVEY

N00014-75-C-0209

UNCLASSIFIED

HIG-CONTRIB-889

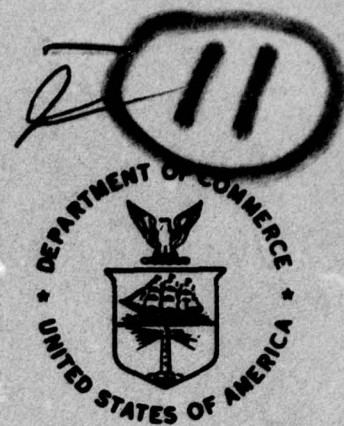
NL

1 of 1
AD
A056 962



END
DATE
FILMED
9-78
DDC

LEVEL ^{II}



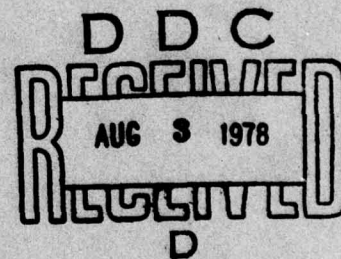
NOAA Technical Memorandum ERL PMEL-11

AD A 056962

CONVERSION FROM FILM TO MAGNETIC CASSETTE RECORDING
FOR THE GEODYNE 102 CURRENT METER

Alex I. Nakamura
Robert R. Harvey

Pacific Marine Environmental Laboratory
Seattle, Washington
April 1978



DISTRIBUTION STATEMENT A

Approved for public release;
Distribution Unlimited

78 07 10 098

AD No. _____
DDC FILE COPY

noaa

NATIONAL OCEANIC AND
ATMOSPHERIC ADMINISTRATION

Environmental
Research Laboratories

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER HIG-889	2. GOVT ACCESSION NO. (9) Technical memo.	3. RECIPIENT'S OR PAGE NUMBER
4. TITLE (and Subtitle) (6) CONVERSION FROM FILM TO MAGNETIC CASSETTE RECORDING FOR THE GEODYNE METER.	5. TYPE OF REPORT & PERIOD COVERED (14) HIG-CONTRIB	6. PERFORMING ORG. REPORT NUMBER HIG Contribution 889
7. AUTHOR(s) (10) Alex I. Nakamura Robert R. Harvey	(12) Current (15)	8. CONTRACT OR GRANT NUMBER(s) N00014-75-C-0209
9. PERFORMING ORGANIZATION NAME AND ADDRESS Hawaii Institute of Geophysics 2525 Correa Rd. Honolulu, HI. 96822	10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS (12) 2 Pp.	11. REPORT DATE Apr 78
11. CONTROLLING OFFICE NAME AND ADDRESS Office of Naval Research Ocean Science & Technology Division Ray, St. Louis MS 39520	12. REPORT DATE Apr 78	13. NUMBER OF PAGES 17
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office) Office of Naval Research Branch Office 1030 East Green Street Pasadena, CA. 91106	15. SECURITY CLASS. (of this report)	16. DECLASSIFICATION/DOWNGRADING SCHEDULE
16. DISTRIBUTION STATEMENT (of this Report) Approved for public release; distribution unlimited.		
17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)		
18. SUPPLEMENTARY NOTES Published in NOAA Technical Memorandum ERL PMEL-11pp.15.April 1978		
19. KEY WORDS (Continue on reverse side if necessary and identify by block number) Geodyne Digital cassette tape recording Digital magnetic tape recording Oceanographic current measurement		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number) This report describes a conversion of the Geodyne 102 current meter, which recorded its data on film, to digital cassette tape recording. Sufficient information is included to enable the reader to implement this modification.		

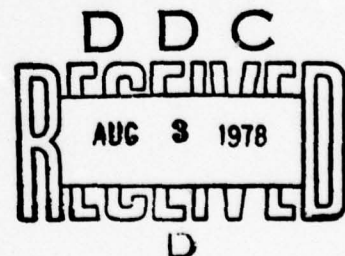
NOAA Technical Memorandum ERL PMEL-11

CONVERSION FROM FILM TO MAGNETIC CASSETTE RECORDING
FOR THE GEODYNE 102 CURRENT METER

Alex I. Nakamura
Robert R. Harvey

Pacific Marine Environmental Laboratory
Seattle, Washington
April 1978

ADDITIONAL FOR	
NPIC	White Section <input checked="" type="checkbox"/>
DRG	Buff Section <input type="checkbox"/>
DISCONTINUED	<input type="checkbox"/>
JUSTIFICATION	
BY	
DISTRIBUTION/AVAILABILITY CODES	
REG.	AVAIL. and/or SPECIAL
A	



UNITED STATES
DEPARTMENT OF COMMERCE
Juanita M. Kreps, Secretary

NATIONAL OCEANIC AND
ATMOSPHERIC ADMINISTRATION
Richard A. Frank, Administrator

Environmental Research
Laboratories
Wilmot N. Hess, Director

78 07 10 098

NOTICE

The Environmental Research Laboratories do not approve, recommend, or endorse any proprietary product or proprietary material mentioned in this publication. No reference shall be made to the Environmental Research Laboratories or to this publication furnished by the Environmental Research Laboratories in any advertising or sales promotion which would indicate or imply that the Environmental Research Laboratories approve, recommend, or endorse any proprietary product or proprietary material mentioned herein, or which has as its purpose an intent to cause directly or indirectly the advertised product to be used or purchased because of this Environmental Research Laboratories publication.

CONTENTS

	Page
Abstract	1
1. INTRODUCTION	1
2. PHYSICAL MODIFICATIONS	1
3. DATA FORMAT	3
4. POWER REQUIREMENTS	4
5. ELECTRONICS DESCRIPTION	4
6. POWER ON SEQUENCE	13
7. TEST CIRCUIT	14
8. ACKNOWLEDGEMENTS	14
9. REFERENCES	15

CONVERSION FROM FILM TO MAGNETIC CASSETTE RECORDING
FOR THE GEODYNE 102 CURRENT METER

A. Nakamura¹ and R. R. Harvey²

Joint Institute for Marine and
Atmospheric Research (JIMAR)

This report describes a conversion of the Geodyne 102 current meter, which recorded its data on film, to digital cassette tape recording. Sufficient information is included to enable the reader to implement this modification.

1. INTRODUCTION

The original Geodyne 102 current meter contained sensors for current speed (savonius rotor), meter azimuth, current direction, and meter tilt. The modifications described here chiefly concern the recording scheme, where the above sensors are little affected.

The Geodyne 102 current meter was first produced in the mid-1960's following the design of Richardson et al. (1963). This instrument became a workhorse of oceanographic current measurement and was used extensively by the military, industry, and research until it was superseded by digital magnetic tape recording units.

2. PHYSICAL MODIFICATIONS

The original film recording instrument is schematically depicted in Figure 1, along with its modified version. We will discuss the modification, beginning at the top and working downwards.

¹ALEX NAKAMURA, PACIFIC MARINE ENVIRONMENTAL LABORATORY.

²ROBERT R. HARVEY, HAWAII INSTITUTE OF GEOPHYSICS, UNIVERSITY OF HAWAII, HONOLULU, HAWAII 96822.

*CONTRIBUTION NO. PMEL 356 FROM NOAA/ERL/PACIFIC MARINE ENVIRONMENTAL LABORATORY.

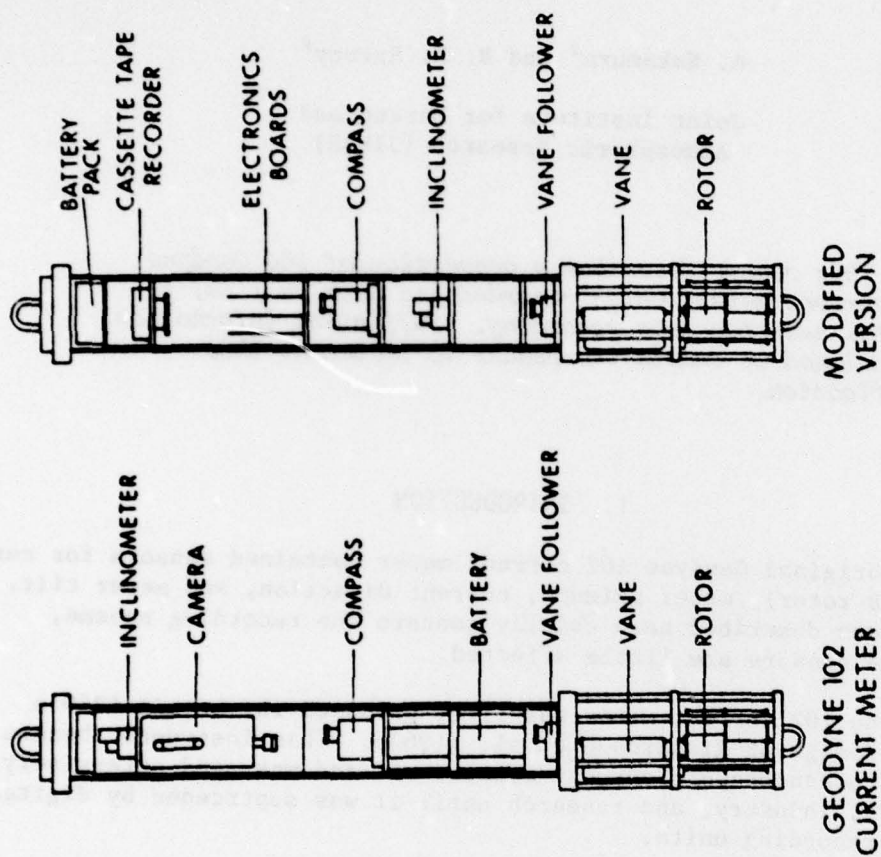


Figure 1. Schematic views of the Geodyne 102 current meter - original and modified versions.

The battery pack consists of nine alkaline "D" cells. Eight of these in series provide 12-volt power for the electronics and tape recorder. The ninth powers a quartz crystal oscillator circuit which serves as a time base for sampling.

Beneath the battery pack lies a Memodyne Inc., Model 201, digital cassette recorder. This recorder is an incremental stepping type which writes with a density of 615 bits per inch. The write/step electronics are located on a printed circuit board, mounted below the stepping motor.

All other electronics are wire-wrapped on three general purpose boards which mount vertically beneath the recorder. These boards measure 4 1/2 X 5 inches and are designated A100, A200 and A300.

The optical encoding scheme for both the compass and vane follower remains unchanged except for replacing the fragile and expensive glass fiber optics with single element plastic fibers. To convert the light coded signals to logic level signals, the light pipes lead to holes in an opaque lucite block, screwed to the tops of the compass and vane follower. Photodarlington transistors recessed into the opposite sides of the blocks then receive the light pulses and pass the signals electronically to the data registers.

The inclinometer is a sealed unit consisting of eight concentric circles of wire suspended above a pool of mercury. The dimensions are arranged such that contact between the mercury and each successive wire corresponds to 5° of tilt.

The vane and rotor are unchanged except for the bearings. Since we intended to use these instruments for deep ocean current measurement, the original threshold current of 2.5 cm/sec was too high. Thus we adapted a design from Sessions (1975) which consists of a .0938" carballoy shaft, inserted into a teflon bushing and resting on a 3/16" dia. synthetic ruby sapphire sphere. These bearings result in a reduction of threshold speed to about 0.5 cm/sec. The approximate cost of modifying one Geodyne 102 current meter as described here is \$1000 in materials and one man-month of labor. Neglecting the original cost of the Geodyne 102 meter, this represents a considerable cost saving compared to comparable, commercially available instruments.

3. DATA FORMAT

Data recorded for each sample include day count, hour count, inclination, compass direction, vane follower position, and rotor counts

consisting of 7, 5, 8, 7, 7, and 10 bits, respectively. Two bit gaps separate consecutive parameters except for the day and hour counts, which are treated as one data word. A sixteen bit end-of-file gap frames each sample to permit synchronization when reading the tape.

Data is recorded at 615 bits per inch, each bit requiring one step of the capstan drive motor. A total of 70 bits (including gaps) comprise a single sample. A 450 foot cassette tape is capable of recording forty-seven thousand samples, which translates to 32 days at a one minute sampling interval.

4. POWER REQUIREMENTS

During the sampling process, the lamps and cassette recorder draw an average of 100 milliamperes for 0.85 seconds, corresponding to about 300 microwatt-hours of energy from the 12 volt battery pack.

Fourteen watt-hours of energy are required to fill one 450 foot cassette. Eight, 10 ampere-hour capacity, alkaline "D" cells connected in series are sufficient to power the system even if battery capacity is reduced by typical ocean-bottom near freezing temperatures.

The time base oscillator draws only 40 microamperes from a 1.5 volt alkaline "D" cell. For all practical purposes, this circuit can run continuously for the shelf life of the battery, so no ON/OFF switch is provided.

5. ELECTRONICS DESCRIPTION

A block diagram of the current meter (Figure 2) shows the general recording scheme. Primary data from the vane, compass, inclinometer, rotation counter, and clock feed in parallel to a data register, consisting of a string of parallel load, serial shift registers. A sample command is initiated by the clock and sample rate generator. This command sequentially flashes the vane and compass lamps, loads data into the data register, clears the rotation counter, serially shifts the data to and steps the digital cassette recorder.

The sequence of events is graphically displayed in the timing diagram, Figure 3. The circuit details for individual circuit boards are shown in Figures 4, 5 and 6, where the interconnections appear in Figure 7. The photodarlington transistor array interconnection is

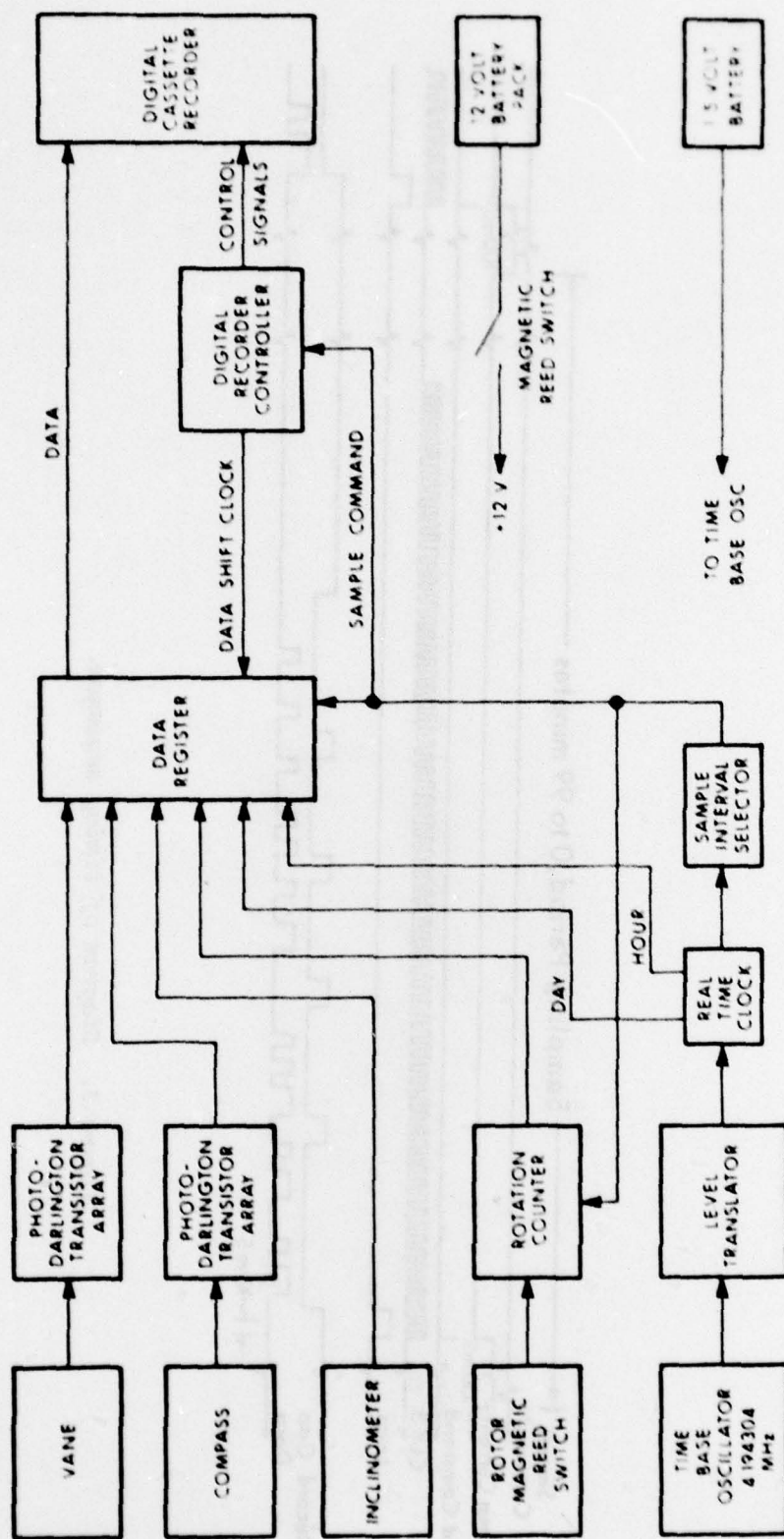


Figure 2. Block diagram of modified Geodyne 102 current meter.

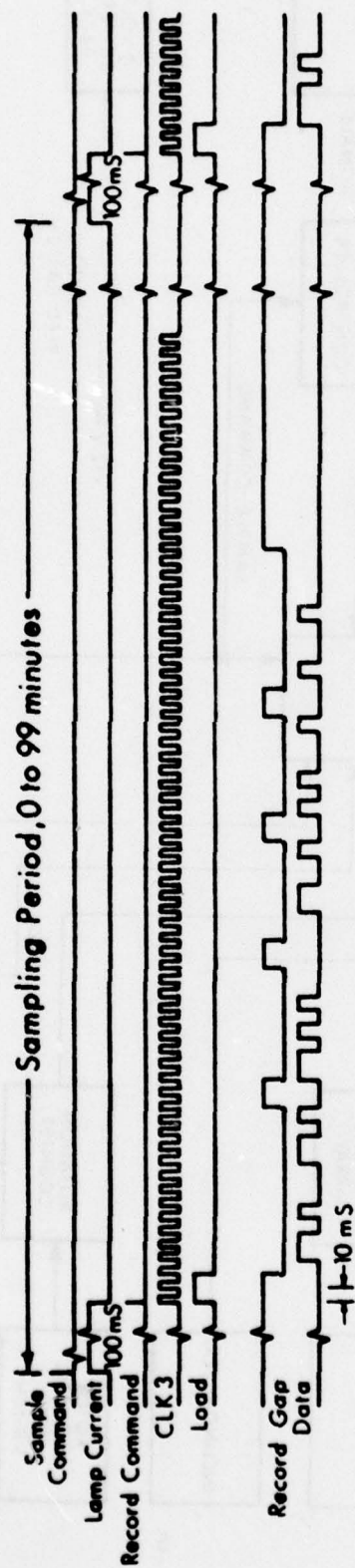


Figure 3. Diagram of timing sequence.

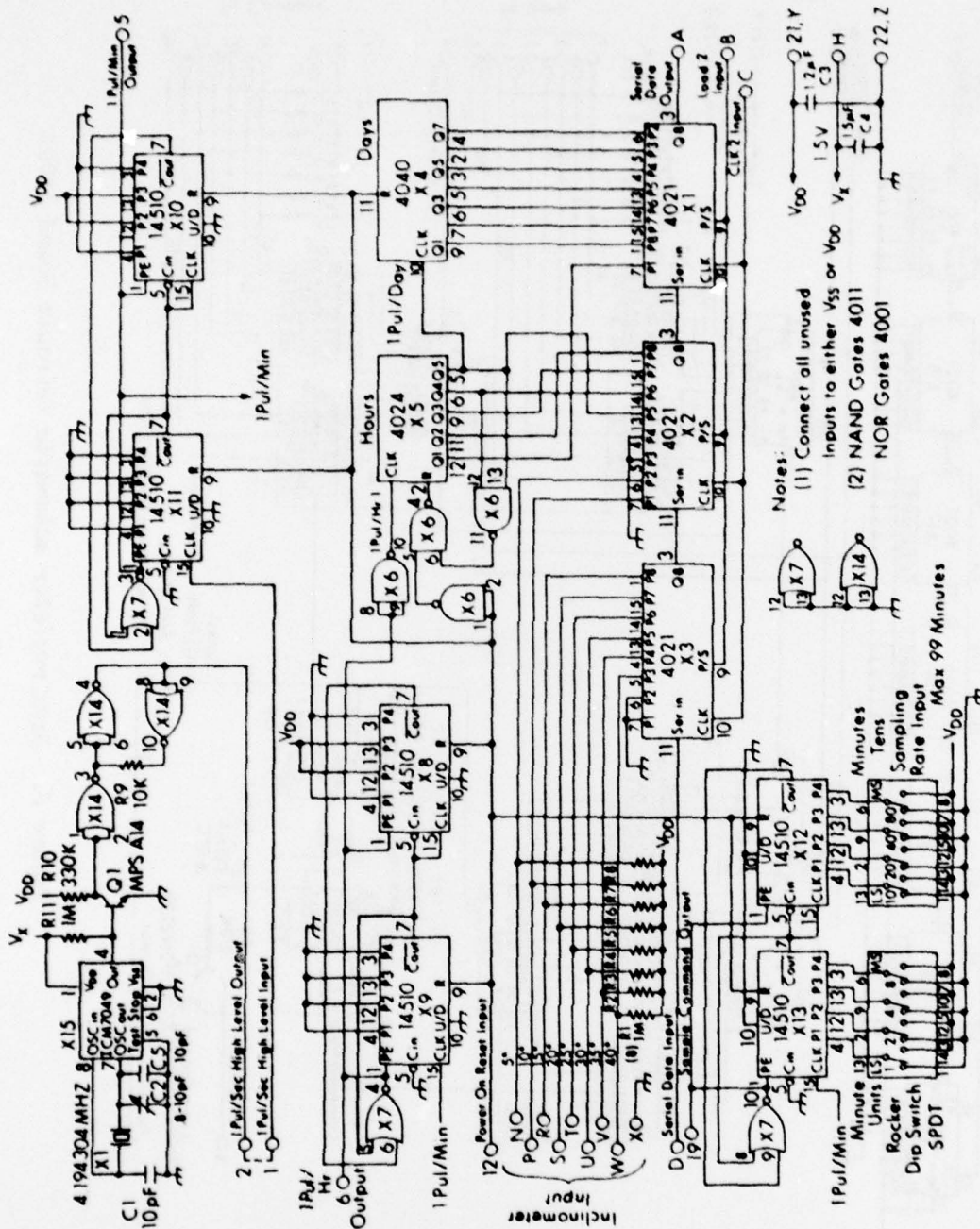


Figure 4. Clock timer schematic (circuit board A100).

THIS PAGE IS BEST QUALITY PRACTICABLE
FROM COPY FURNISHED TO DDC

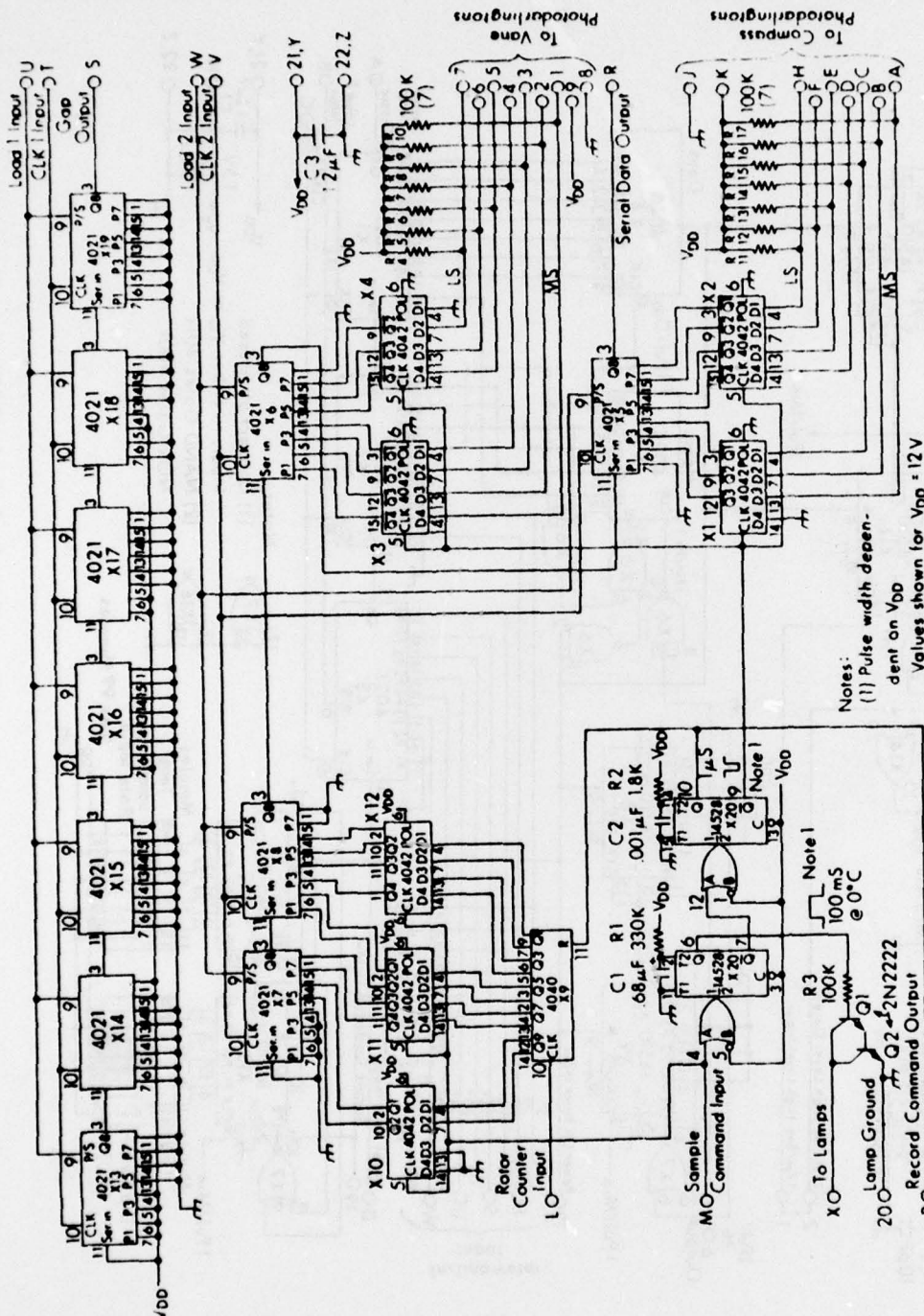


Figure 5. Data register schematic (circuit board A200).



THIS PAGE IS BEST QUALITY PRACTICABLE
FROM COPY FURNISHED TO DDG

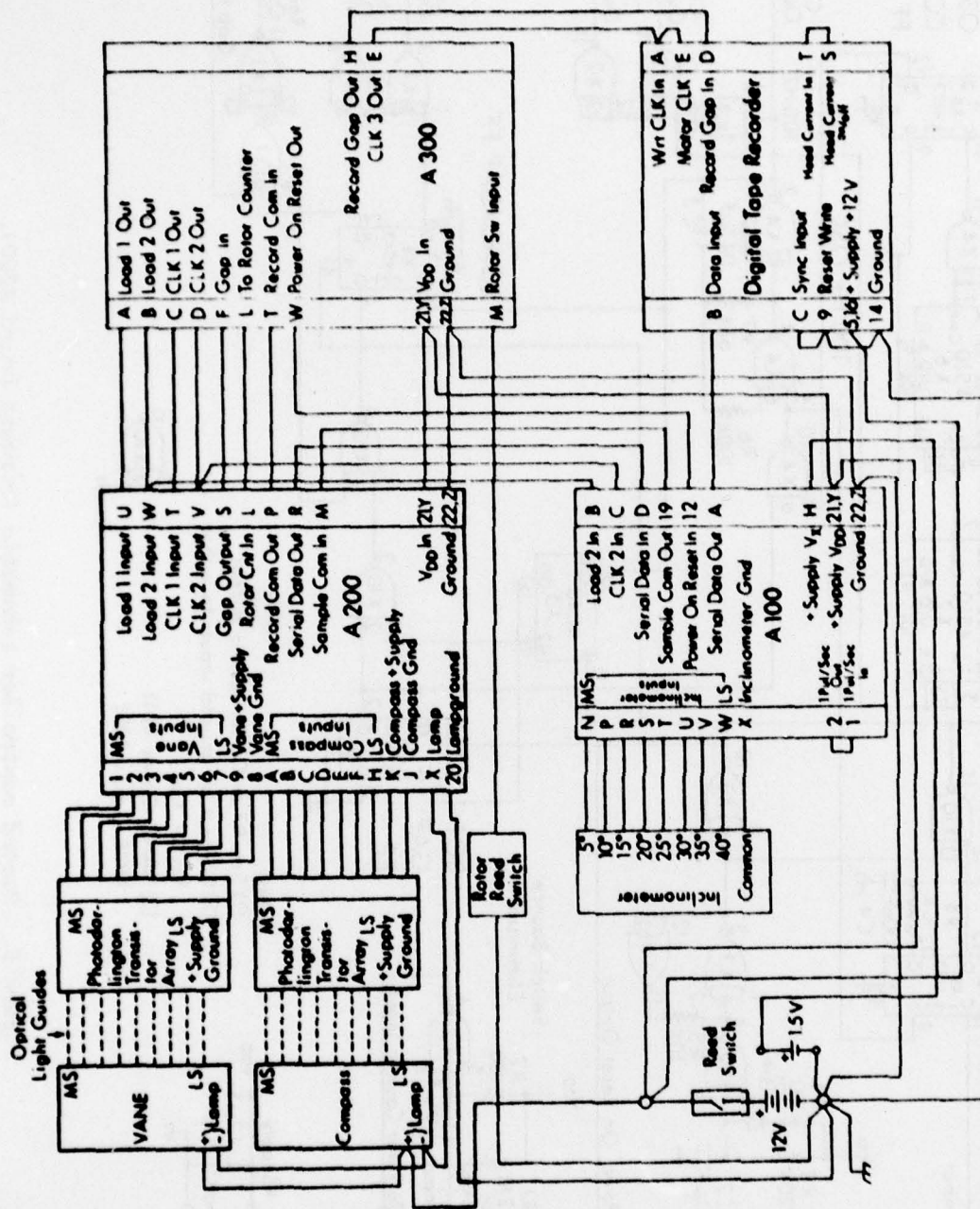


Figure 7. Wiring harness diagram.

shown in Figure 8. Circuit components are labelled by a code referring to the board number and component number, for example, X309 denotes the integrated circuit (IC) X9 on circuit board A300.

An oscillator containing a 4.194304 MHz crystal and X115 forms the current meter's time base. This circuit operates from a single 1.5 volt alkaline "D" cell and draws so little current (40 μ a) that it is allowed to run continuously. The output level of X115 is boosted to the 12-volt logic level of the remaining circuitry by darlington transistor Q101 and resistor R110.

NOR gates in X114 form a Schmitt trigger which decreases the rise time of the output of Q101. The 1 Hz output from X114 feeds a divide-by-sixty counter (X110, X111, X107) to produce one pulse/min. at X107-3. This frequency is again divided by sixty (X108, X109, X107) to generate one pulse/hour. The once-per-hour pulses are inverted by X106 and fed to a 24-hour counter, X105, whose output is accumulated by a day counter, X104.

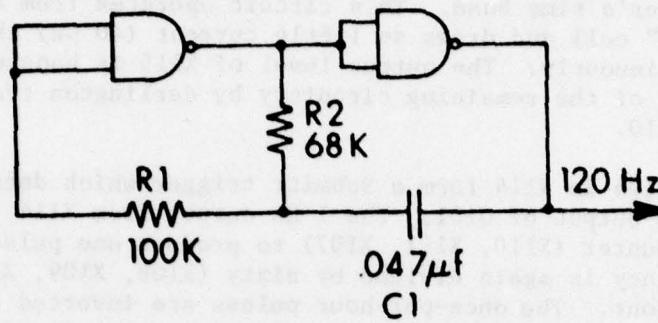
The once-per-minute signal from X107-3 also feeds the programmable sampling rate counter (X112, X113, X107) which can be set to sample from one to 99 minutes by the SPDT DIP switches below X112 and X113 in Figure 4. The "sample command" signal from X107-10 starts the recording cycle as shown in Figure 3.

Current speed is sensed by a Savonius rotor with two magnets attached. Upon rotation of the rotor, the magnets activate a reed switch whose closure is "debounced" by X302, R301, R302 and C301. The number of switch closures, proportional to rotor counts, then accumulates in counter X209.

Upon receipt of the sample command signal, the circuit simultaneously samples the accumulated rotor counts and the instantaneous vane and compass positions. The data from rotation counter X209 are loaded into data latches X210, X211, and X212. The first one-shot in X220 turns on transistors Q201 and Q202, lighting the vane and compass lamps. These are activated for 100 ms. to allow them to reach maximum brightness. The trailing edge of the 100 ms "lamps on" pulse triggers the second one-shot in X220, generating a 1 μ s record command pulse. This clears rotation counter X209 and initiates writing of the data onto tape.

The record command pulse from X220-10 triggers the record command one-shot, X309. This parallel loads the digital recorder step counters, X306 and X307, sets oscillator control flip-flop X308, clears counter X305, and resets load/gap flip-flop, X308. Note that both the oscillator

Note: Trim R₂ or C₁
for 120 Hz output



Notes: 1. Photodarlington
transistor part
number OP 830
2. Cut off base leads
to reduce noise
pick up.

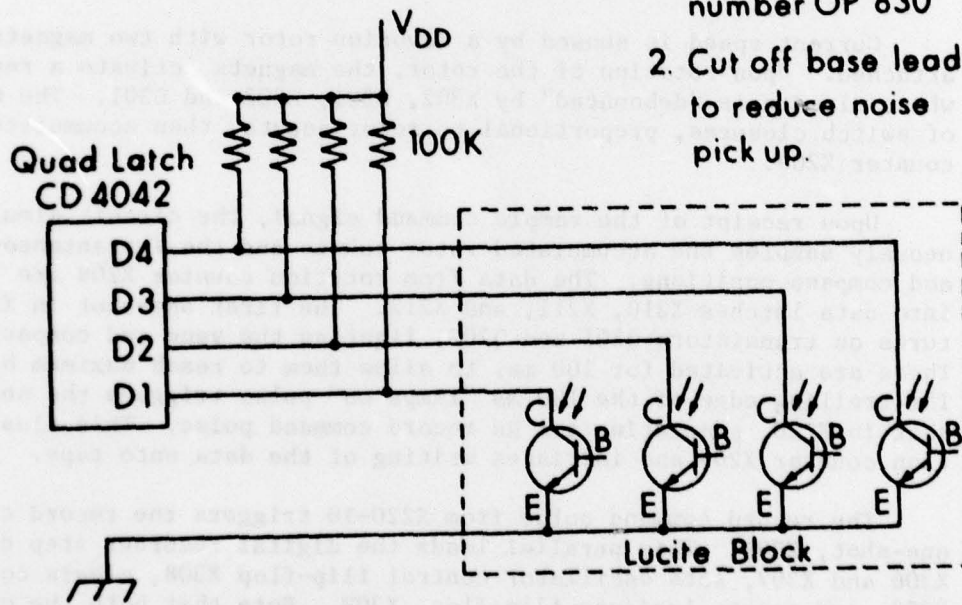


Figure 8. Test oscillator and photodarlington array schematics

control flip-flop, X308, and beginning of tape gap (BOT) flip-flop, X309, must be in the reset state in order to trigger the record command one-shot. This interlock scheme ensures that one write cycle is completed before another can begin.

Setting the oscillator control flip-flop enables the 100 Hz oscillator causing clock pulses to appear at CLK3, CLK1, and CLK2, (see the timing diagram, Figure 3).

The first two steps of the recorder (one step per clock pulse) represent a gap, since the load/gap flip-flop, X308, is in the reset state. During this time the load outputs, LOAD 1 and LOAD 2, are at a high level, causing the data to be loaded into parallel-to-serial converters X101 - X103, X213 - X219 and X205 - X208. Upon the high-low transition of the second clock pulse, counter X305-7 goes high, causing a high level to appear at input D of the load/gap flip-flop, X308. At the low-high transition of the third clock pulse, X308-2 drops the load and gap signals to low level. At this point, subsequent clock pulses write the data onto tape, since the gap signal to the recorder is low. The load/gap flip-flop, X308, is maintained in the set state for the rest of the cycle by feedback from X310-4.

Data words are written with two-bit gaps, generated by a string of shift registers (parallel-to-serial converters X213-X219). "1" bits correspond to gaps and "0" bits to data positions. The data shift registers, X101 - X103, X205 - X208, and gap shift registers, X213 - X219, are shifted out in parallel, with the gap output feeding the record gap input and the data output feeding the data input of the cassette recorder.

6. POWER ON SEQUENCE

The current meter is activated by removing a magnet external to the pressure case. This closes a magnetic reed switch and applies power to the circuits. Application of power to X303 generates a reset pulse; the Schmitt trigger formed by X303 and R305 holds the output of X303-3 low for about 1.5 ms; it then rises sharply and remains high. This power on reset initializes all counters and flip-flops.

The reset pulse clears counter X305, resets load/gap flip-flop X308, and sets flip-flop X309, causing a 1024 step gap to be written at the beginning of the tape cassette. This gap is subsequently used as a starting point for reading the tape. The low level at X309-2 causes a high output on X304-10, enabling the 100 Hz oscillator, composed of X304, R306, R307, and C303. Clock pulses at CLK3 cause the recorder to increment one step per pulse.

As long as X309-2 remains low and X308-2 remains high, the "record gap" output is high and the recorder writes only gaps. When counter X305 accumulates 1024 counts, X305-15 goes high. This clocks flip-flop X309 disabling the 100 Hz oscillator and stopping the recorder. Beginning of tape (BOT) flip-flop, X309, then remains in the reset state for the rest of the mission.

7. TEST CIRCUIT

It is frequently desirable to accelerate the sampling rate in order to test or troubleshoot the circuitry efficiently. Accordingly, we use the circuit shown in Figure 8 to effect this option. With the sampling switch set at two minutes and the test circuit applied, samples are written at one Hz. The 12-volt D.C. and ground jacks are connected to power pins on any one of the circuit boards. The 120 Hz output connects to pin 1 on the printed circuit board connector for board A100, after removing the jumper between pins 1 and 2.

8. ACKNOWLEDGEMENTS

The Geodyne 102 current meter conversion is among the many joint National Oceanic and Atmospheric Administration-University of Hawaii projects which were initiated by the late Gaylord R. Miller. This project was supported by the Joint Tsunami Research Effort of the Pacific Marine Environmental Laboratory and Office of Naval Research contract N00014-75-C-0209.

9. REFERENCES

Richardson, W. S., P. B. Stimson and C. H. Wilkins, 1963: Current measurements from moored buoys, *Deep-sea Res.* 10, 369-388.

Sessions, M., 1975: Improved free vehicle current meter system, *Exposure* 3 (4), 1-3.